

## Topic 02 – SL/HL Atomic Structure Exam

Name.....

1. What is the electron configuration for the chromium (1+) ion, ( $Z = 24$ )?

- A.  $[\text{Ar}]4s^13d^4$   
 B.  $[\text{Ar}]3d^5$   
 C.  $[\text{Ar}]4s^23d^4$   
 D.  $[\text{Ar}]4s^13d^5$

2. What is the electron arrangement of silicon?

- A. 2.4  
 B. 2.8  
 C. 2.8.4  
 D. 2.8.8

3. Which species has 54 electrons and 52 protons?

- A.  $^{128}_{52}\text{Te}^{2-}$   
 B.  $^{132}_{54}\text{Xe}^{2+}$   
 C.  $^{132}_{54}\text{Xe}^{2-}$   
 D.  $^{128}_{52}\text{Te}^{2+}$

4. Which is correct about the element tin (Sn) ( $Z = 50$ )?

	Number of main energy levels containing electrons	Number of electrons in highest main energy level
A.	4	4
B.	4	14
C.	5	4
D.	5	14

5. Information is given about four different atoms:

atom	neutrons	protons
W	22	18
X	18	20
Y	22	16
Z	20	18

Which **two** atoms are isotopes?

- A. W and Y  
 B. W and Z  
 C. X and Z  
 D. X and Y

6. How many electrons are there in **all** the d orbitals in an atom of xenon?

- A. 10  
 B. 18  
 C. 20  
 D. 36

7. The electron arrangement of sodium is 2.8.1. How many occupied main electron energy levels are there in an atom of sodium?

- A. 1  
 B. 3  
 C. 10  
 D. 11

8. Which ion would undergo the greatest deflection in a mass spectrometer?

- A.  $^{42}\text{Ca}^+$   
 B.  $(^{40}\text{Ca}^{42}\text{Ca})^+$   
 C.  $^{40}\text{Ca}^{2+}$   
 D.  $^{42}\text{Ca}^{2+}$

9. What is the difference between two neutral atoms represented by the symbols  $^{59}_{27}\text{Co}$  and  $^{59}_{28}\text{Ni}$ ?

- A. The number of neutrons only.
- B. The number of protons and electrons only.
- C. The number of protons and neutrons only.
- D. The number of protons, neutrons and electrons.

10. A certain sample of element Yz contains 33% of  $^{85}\text{Yz}$  and 67% of  $^{89}\text{Yz}$ . What is the relative atomic mass of element Yz in this sample?

- A. 86.5
- B. 88.6
- C. 87.0
- D. 87.7

11. How many protons, neutrons and electrons are there in the species  $^{26}\text{Mg}^{2+}$ ?

	Protons	Neutrons	Electrons
A.	10	14	12
B.	12	14	10
C.	12	26	10
D.	14	12	12

12. How many valence electrons are present in an atom of an element with atomic number 16?

- A. 2
- B. 4
- C. 6
- D. 8

13. Which statement is correct for the emission spectrum of the hydrogen atom?

- A. The lines converge at lower energies.
- B. The lines are produced when electrons move from lower to higher energy levels.
- C. The lines in the ultraviolet region involve electron transitions into the energy level closest to the nucleus.
- D. The line corresponding to the greatest emission of energy is in the visible region.

14. Which is related to the number of electrons in the outer main energy level of the elements from the alkali metals to the halogens?

- I. Group number
- II. Period number

- A. I only
- B. II only
- C. Both I and II
- D. Neither I nor II

15. Energy levels for an electron in a hydrogen atom are

- A. closer together near the nucleus.
- B. arranged randomly.
- C. evenly spaced.
- D. farther apart near the nucleus.

16. (a) List the following types of electromagnetic radiation in order of **increasing** wavelength (shortest first).

- I. Orange
- II. Blue
- III. Ultraviolet radiation .....
- IV. Infrared radiation

(1)

(b) ASSUME there were only five energy levels electrons and there were 4 electrons in the excited state, using a Bohr model, diagram the path of the electron for each of the above emissions.

(5)

(Total 6 marks)

17. The percentage composition by mass, given from a mass spec, of a compound is N = 87.3% and H = 12.6%.

- (a) Calculate the empirical formula of the compound.

(2)

- (b) If the 0.20 moles of the compound has a mass of 6.41 grams, find the relative molecular mass of the compound and its molecular formula based on it and part (a)

(2)

(Total 4 marks)

18. (a) Define the term *isotope*.

(2)

- (b) A sample of argon exists as a mixture of three isotopes.

mass number 36, relative abundance 0.337%

mass number 38, relative abundance 0.0630%

mass number 40, relative abundance 99.6%

Calculate the relative atomic mass of argon.

(2)

- (c) State the number of electrons, protons and neutrons in the ion  $^{56}\text{Fe}^{3+}$ .

electrons: ..... protons: ..... neutrons: .....

(2)

(Total 6 marks)

19. (a) Evidence for the existence of energy levels in atoms is provided by line spectra.  
State how a line spectrum differs from a continuous spectrum.

(1)

- (b) On the diagram below draw **four** lines in the visible line spectrum of hydrogen.

(1)



(Total 2 marks)

20. (i) State the full electron configuration for argon.

(1)

- (ii) Give the formulas of **two** oppositely charged ions which have the same electron configuration as argon.

(2)

(Total 3 marks)

22. Define the following terms.

- (i) *atomic number*

(1)

- (ii) define *mass number*

(1)

(Total 2 marks)

23. State the electron arrangements (or configuration) of the following species:

Si .....

$\text{P}^{3-}$  .....

(Total 2 marks)

24. Naturally occurring copper has a relative atomic mass, ( $A_r$ ), of 63.55 and consists of two isotopes  $^{63}\text{Cu}$  and  $^{65}\text{Cu}$ .

(i) Define the term *relative atomic mass*,  $A_r$ .

(1)

(ii) State and explain which is the more abundant isotope. (No need to calculate)

(1)

(Total 2 marks)

25. Identify the numbers of protons, neutrons and electrons in the species  $^{33}_{16}\text{S}^{2-}$ .

(Total 1 mark)

26. (a) Describe the following stages in the operation of the mass spectrometer.

(i) ionization

(2)

(ii) deflection

(2)

(iii) acceleration

(1)

(b) (i) Calculate the percentage abundance of the two isotopes of rubidium  $^{85}\text{Rb}$  and  $^{87}\text{Rb}$ .

(2)

(ii) Determine the full electron configuration (not arrangement) of an atom of a neutral Si atom, an  $\text{Fe}^{3+}$  ion and a  $\text{P}^{3-}$  ion.

(3)

(Total 10 marks)